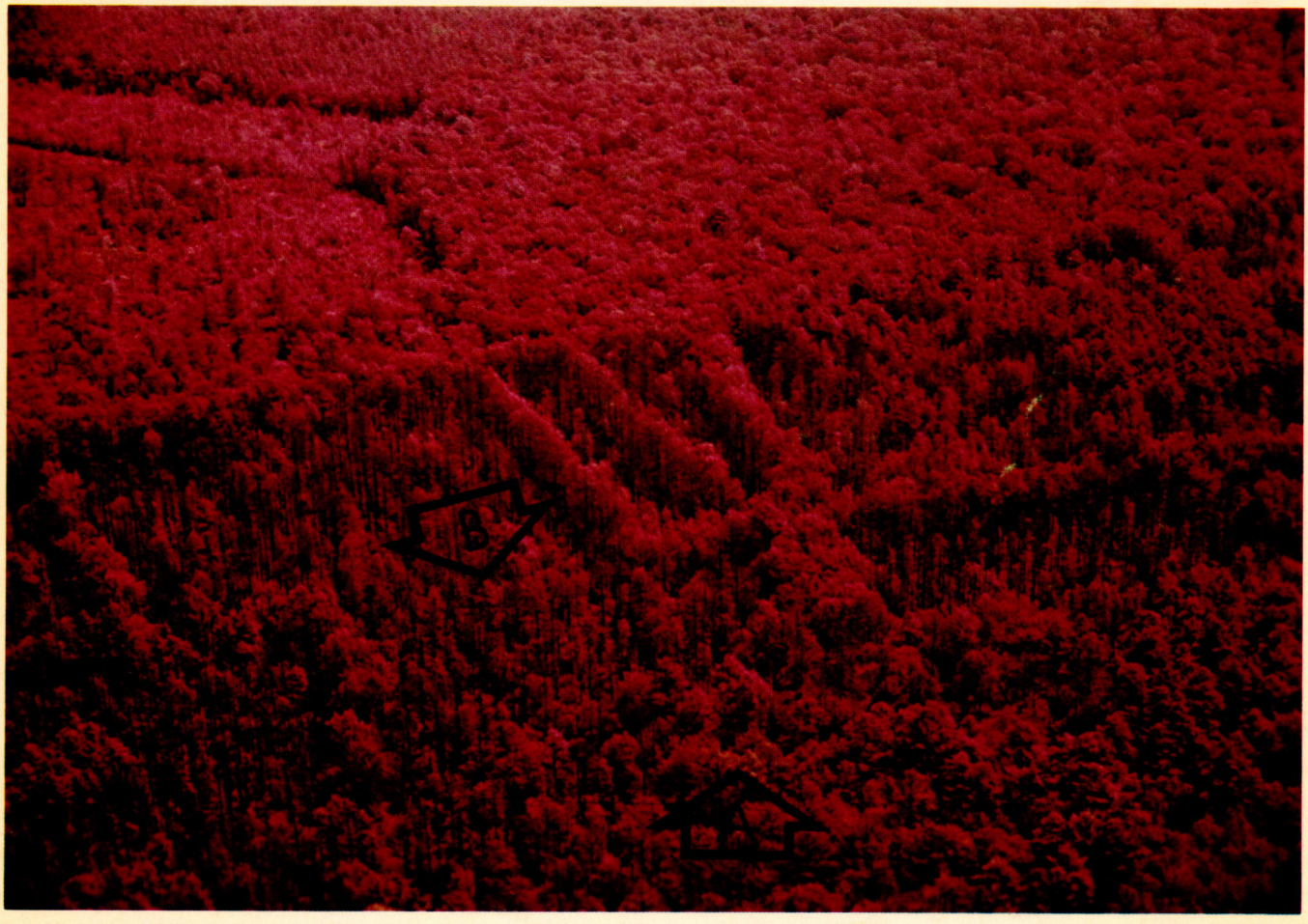
SB741
.F6
1971

SOUTHERN PINE BEETLE EVALUATION ON THE DELMARVA PENINSULA - 1971



U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
NORTHEASTERN & SOUTHEASTERN AREAS, STATE & PRIVATE FORESTRY
FOREST PEST MANAGEMENT, ENVIRONMENTAL PROTECTION & IMPROVEMENT UNIT

LIBRARY
DEC 16 1971
ROCKY MOUNTAIN STATION

COVER STORY

Color infrared aerial photographs facilitated surveys of southern pine beetle damage on the Delmarva Peninsula. "A" indicates a small group of yellowish loblolly pine faders, recently killed by *D. frontalis*. "B" indicates previously killed snags.

SOUTHERN PINE BEETLE EVALUATION ON THE DELMARVA PENINSULA - 1971

By

J. B. HANSON[1/], P. J. BARRY[2/], AND B. H. BAKER[1/]

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
NORTHEASTERN & SOUTHEASTERN AREAS, STATE & PRIVATE FORESTRY
FOREST PEST MANAGEMENT, ENVIRONMENTAL PROTECTION & IMPROVEMENT UNIT

1/ Entomologists, Delaware, Ohio

2/ Entomologist, Asheville, North Carolina

CONTENTS

	Page
ABSTRACT	1
INTRODUCTION	1
History of outbreaks	3
Delmarva Pine Beetle Council	3
Physiography	4
Climate	4
METHODS	4
RESULTS AND DISCUSSION	5
Damage assessment and population trends	5
Stand composition	6
Radial increment	9
Soil conditions	9
Climatological Data	9
CONCLUSIONS AND RECOMMENDATIONS	13
LITERATURE CITATIONS	14

Abstract

The southern pine beetle, *Dendroctonus frontalis* Zimm., continues to cause considerable loblolly and Virginia pine mortality on the Delmarva Peninsula of Delaware, Maryland and Virginia. In the six counties surveyed, Worcester County, Maryland, and Accomack County, Virginia, had the highest incidence of beetle activity and, subsequently, the highest potential for damage in 1972. These two counties had an estimated 16 spots or groups of infested trees per thousand acres of host type; the total number of red-topped and fading trees in these spots was 80. In the remaining four counties, numerous red tops and faders were found but currently infested trees were scarce; this indicates a reduced beetle population to initiate damage in 1972.

The typical stand being attacked by the beetle is approximately 35 years old, has reduced radial increment, has dense stocking, is found on poorly drained soils, and has experienced precipitation abnormalities. This evaluation survey represented 1.12 million acres of the Delmarva Peninsula.

INTRODUCTION

In August and September, 1971, Forest Pest Management personnel from the Northeastern and Southeastern Areas cooperatively conducted an evaluation of one county each in Delaware and Virginia and four counties in Maryland (Fig. 1). This evaluation consisted of an aerial photographic survey with a subsequent ground survey representing 1.12 million acres. The results of photographic interpretations, ground checking, radiographic bark sampling and stand site analysis are presented to aid the states in control, salvage and management decisions.

Forest Service participants in the survey were J. B. Hanson, B. H. Baker, W. Lautz, J. M. Reid, D. G. Holland, Northeastern Area; P. J. Barry, J. D. Ward, W. H. Clerke, W. E. McDowell, Southeastern Area; D. R. Hangartner, Region 9; and D. Carroll, Region 8. Thanks are extended to the Maryland Department of Forests and Parks personnel who aided in this survey.

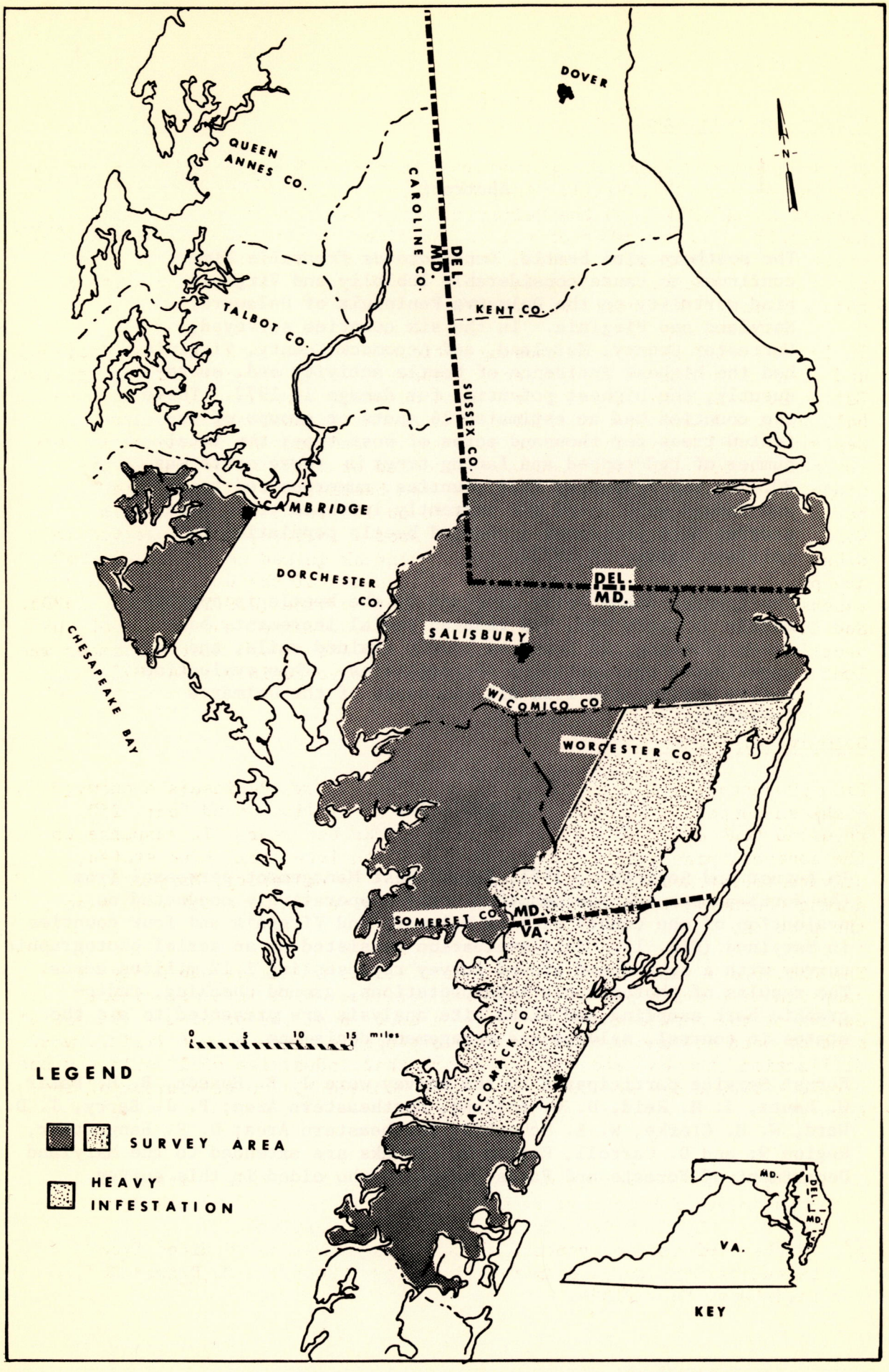


FIG. I AERIAL SURVEY OF DELMARVA PENINSULA

History of outbreaks[3/]

The southern pine beetle, *Dendroctonus frontalis* Zimm., has been a recurring problem in loblolly pine, *Pinus taeda* L., and Virginia pine, *P. virginiana* Mill., on the Delmarva Peninsula of Delaware, Maryland and Virginia for a number of years. Earliest reports by Craighead (1925) describe two outbreaks of the beetle, one near Ashland, Virginia, and another near Accomack, Virginia. The next known report of any appreciable damage by the beetle was in 1955.

In 1960-61, the beetle was causing noticeable tree losses in both Maryland and Virginia and as a result, aerial surveys were conducted in both states. Estimated losses in Virginia from that outbreak were approximately one-half million board feet of timber. Hurricane "Donna" which occurred in September, 1960, was thought to be a major predisposing influence in this outbreak as many of the trees were uprooted or weakened by the severe winds. In 1964-65, reports indicated the beetle was again causing noticeable damage. A survey in 1965 found 100 infestation spots in Worcester County, Maryland; only a few spots, however, were observed in other Maryland counties. The present outbreak gained notoriety in 1969 and prompted landowners to ask that seriousness of the beetle damage be assessed. Subsequent surveys by the Forest Service (U.S.F.S. Reps. 1970a. and 1970b., Clerke, Hanson and Barry, 1971) documented the impact of the beetle in 1969 and 1970. An estimated 55 million board feet of timber was lost to the southern pine beetle on the Delmarva Peninsula in 1970.

Delmarva Pine Beetle Council[4/]

Pine products are an important part of the Delmarva Peninsula economy; eighteen companies produce approximately 100 million board feet, 250 thousand tons of chips, and 95 thousand cords per year. In response to the southern pine beetle outbreak, representatives from three states, private industries and federal agencies met in Salisbury, Maryland, during February, 1971, to formulate what course could be taken to ease the problem.

The combined efforts of Council members led to a massive publicity campaign with brochures and newspaper articles which informed timber owners of the beetle and what could be done about the problem. The establishment of wood storage yards, changing of logging truck weight limits, wood utilization studies, and the commitment that industries would only purchase beetle-killed trees are but some of the commendable contributions of the Council.

3/ Compiled from information received from C. L. Morris, Virginia Department of Forestry; R. L. Altman, University of Maryland; and T. J. Lyon, Chief, Forest Management, Maryland.

4/ Further information concerning the Council may be obtained from Executive Secretary, Delmarva Pine Beetle Council, PO Drawer "R", Salisbury, Md., 21801.

Physiography

The counties included in the survey are situated in the Atlantic Coastal Plain physiographic province and are located on a peninsula lying between the Atlantic Ocean and Chesapeake Bay. Most of the area is low eroded plain with maximum elevations around 85 feet above sea level. Often subtle differences in elevation have a large effect on the soil type, drainage, and the nature of vegetation on a particular area. Although the terrain appears monotonous to the eye, closer observations will distinguish terraces, natural as well as artificial stream channels, remnant dunes, swamps and marshes. Some areas lie only a few feet above sea level or grade into marshland or salt water tidal marshes.

Climate

The climate of the area is humid continental to semicontinental, modified by the nearness to large bodies of water. The prevailing winds are westerly, but in the cooler portion of the year, low pressure systems along the coast bring cool, wet weather. The annual precipitation averages about 45 inches with fairly good distribution throughout the year. In the summer, rainfall occurs mostly in showers and thunderstorms, which may bring heavy rain to some areas and only a sprinkle to another. The available soil moisture as a result of variable storms differs markedly from area to area. In the winter months, the precipitation occurs over large areas and may last for several days. During an average winter, a freezing temperature of 32°F or lower can be expected on about 90 days. A temperature of 0°F or lower is rare.

METHODS

Aerial photographs were taken of sample plot locations within the survey area that includes the counties of Dorchester, Somerset, Wicomico, and Worcester in Maryland; Accomack in Virginia, and Sussex in Delaware (Fig. 1). The plots (547) were located at 1 3/4-mile intervals along flight lines spaced 1 3/4 miles apart. This gave ten per cent coverage of the survey area.

The plots were then photographed with either a K-17 12-inch focal length lens or a T-11 6-inch focal length lens aerial camera using Kodak Infrared Aerial Color film types SO-117 or 2443 with appropriate filters[5/].

5/ The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U. S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Color infrared film was used because it provides good haze penetration, excellent differentiation between hardwood and pine species, and it accentuates the color differences between dying and healthy pines. Interpretation of photographs was accomplished by first marking the boundaries of a 200-acre plot in the center of the overlap area of each stereo pair. A photo interpreter using an Old Delft stereoscope located the suspected beetle spots and marked dying pine trees on each photo plot. Interpretation was confined to plots containing 25 per cent or more pine.

Ground checks were conducted on 72 infestion spots detected on the film. These spots were distributed in the counties as follows: Accomack 16; Dorchester 3; Somerset 15; Sussex 5; Wicomico 11; and Worcester 22. During ground checks, the number of trees in each of three color categories and the number of currently infested trees per spot were determined. In addition, bark samples from infested trees were collected and radiographed for determination of beetle brood density. Data from the aerial and ground survey were analyzed according to the method developed by Forest Pest Management, Southeastern Area (U. S. Forest Service, 1970c.).

Fifty-one 1/10 acre circular plots were established to determine the stand characteristics of loblolly pine in areas sustaining current southern pine beetle attack. Plot locations were taken from aerial photographs of known infestation spots. The plots were distributed in counties as follows: Accomack 11; Dorchester 2; Somerset 14; Sussex 4; Wicomico 9; and Worcester 11. Field crews then followed an arbitrary procedure for pre-selecting plot centers. All plots were in planted or naturally occurring pure loblolly pine stands. Tree diameters were measured at breast height to the nearest 1-inch class. Additionally, five trees per plot center were bored for radial growth trends.

Forty-four southern pine beetle infestation spots were arbitrarily selected in four Maryland counties for determination of soil association and drainage condition. Stands and their soil associations were located on soil survey maps assembled for each county by the Soil Conservation Service (Matthews, 1963; Matthews and Hall, 1966; Hall, 1970; U. S. Soil Conservation Service, in preparation).

Climatological data for Salisbury, Maryland, and Painter, Virginia, were obtained from the National Oceanic and Atmospheric Administration, Environmental Climatic Center, Asheville, North Carolina.

RESULTS AND DISCUSSION

Damage assessment and population trend

Two hundred and forty spots suspected to be the result of bark beetle attack were detected on the photographs. Ground examinations were made on 72 spots containing 2,737 trees of which 314 were currently infested with the southern pine beetle.

Analysis of data from this survey indicate that epidemic southern pine beetle populations were concentrated in Worcester County, Maryland, and Accomack County, Virginia (Table 1). Worcester County had 46.5 ± 32.6 (90 per cent probability) infested trees per 1,000 acres of host type and a brood density of 177 insects per square foot of bark surface. Accomack County had 192.4 ± 81.8 infested trees per 1,000 acres of host type with a brood density of 219 insects per square foot of bark surface. In the remaining three counties in Maryland and one in Delaware, numerous red-topped trees and faders were observed, but currently infested trees were scarce (Table 1). Although the mean infested tree estimates in Worcester and Accomack Counties carry high sampling errors, they, combined with high brood densities, indicate a possible potential for population increase in 1972. In the remaining four counties, low infested tree estimates together with low brood densities indicate a possible population decline for 1972.

Comparison of data from a previous survey in January, 1971, (Clerke et al.) shows that epidemic populations are still concentrated in Worcester and Accomack Counties. This comparison also indicates that the number of spots had increased, although the size of individual spots had decreased from January (Table 2). Brood counts, although they remain high, were substantially lower than in January 1971.

Stand composition

The distribution of tree numbers and basal area per acre by diameter classes are depicted for all plots in Fig. 2. Diameter structure follows a characteristic distribution for an unthinned even-aged stand; small diameter trees are abundant with the curve skewed toward the low frequencies of large diameter trees[6/]. The modal diameter lies between the 5- and 8-inch classes. Modal basal area shifts right to the 11- and 12-inch classes, larger trees exerting greater influence on that variable. Two of the most heavily infested counties, Worcester and Accomack, had diameter and basal area curves very similar to those for pooled data. The mean total number of stems per acre is 242 and the mean total basal area per acre is 123 square feet.

Southern pine beetle occurrence has been associated with overstocked stands having declining growth rates (Thatcher[7/], Osgood[8/], and Bennett, 1965). Silviculturally, the potential for thinning certainly exists in the stands sampled. Thinning would increase annual radial increment

6/ Mean frequencies of trees per plot were, for the 5- and 6-inch classes combined, 5.14 ± 1.8 (95 per cent probability) and for the 7- and 8-inch classes combined, 4.84 ± 1.2. Sampling errors increased, of course, as large diameters were less frequently recorded.

7/ Thatcher, R. C. 1971. Personal communication.

8/ Osgood, E. A. 1971. Personal communication.

Table 1. Summary of southern pine beetle survey data for six counties on the Delmarva Peninsula, September 1971.[1/]

Survey Unit	Total Acreage	Per cent Survey	Spots per M acres host type	Red-topped and fading trees per M acres host type	Infested trees Per M acres host type	Estimated total no. spots (aerial estimate)	Estimated total no. red-topped and fading trees (aerial estimate)	Estimated total no. of infested trees (ground estimate)	Ave. brood density per square foot
Accomack	220,240	9.5	15.6 ± 4.4	84.2 ± 32.8	192.4 ± 81.8	739	3,991	9,119	219
Dorchester	94,240	9.5	8.0 ± 6.0	74.4 ± 82.6	8.0 ± 25.5	63	588	63	--- [2/]
Somerset	197,720	9.1	12.2 ± 5.5	42.2 ± 21.1	8.9 ± 8.3	340	1,177	248	185
Sussex	130,000	9.3	10.3 ± 7.2	33.1 ± 26.2	36.9 ± 56.1	97	311	347	---
Wicomico	210,680	11.0	8.1 ± 4.0	22.7 ± 15.2	19.8 ± 21.9	146	409	356	---
Worcester	258,200	9.9	15.9 ± 4.6	80.8 ± 37.6	46.5 ± 32.6	1,084	5,511	3,171	177

1/ 90 per cent confidence limits.
2/ No currently infested trees found.

Table 2. Summary of southern pine beetle survey data for Accomack County, Virginia, and Worcester County, Maryland January 1971[1/] and September [2/].

Survey Unit	Total Acreage	Per cent Survey	Spots per M acres host type	Red-topped and fading trees per M acres host type	Infested trees per M acres host type	Estimated total no. spots (aerial estimate)	Estimated total no. red-topped and fading trees (aerial estimate)	Estimated total no. of infested trees (ground estimate)	Ave. brood density per square foot
Accomack County, Virginia January 1971	84,480	3.7	10.8 ± 4.7	101.4 ± 53.6	119.7 ± 61.9	255	2,398	2,831	359
Accomack County September 1971	220,240	9.5	15.6 ± 4.4	84.2 ± 32.8	192.4 ± 81.8	939	3,991	9,119	219
Worcester County, Maryland January 1971	306,560	3.3	7.8 ± 2.9	73.3 ± 26.8	218.8 ± 127.3	837	7,865	23,475	388
Worcester County September 1971	258,200	9.9	15.9 ± 4.6	80.8 ± 37.6	46.5 ± 32.6	1,084	5,511	3,171	177

1/ 68 per cent confidence limits.
2/ 90 per cent confidence limits.

and would reduce a tree stress that may possibly contribute to overall stand susceptibility. A thinning technique applied to loblolly pine plantations of eastern Maryland is discussed in some detail by Little, Mohr, and Mook (1968). Both the Forest Service and the Delmarva Pine Beetle Council have in the past recognized the need for future changes in loblolly management techniques.

Radial increment

Increment cores taken from 51 plots indicate an overall growth reduction in recent years (Fig. 3). The radial increment for 1967 through 1971 was reduced by 73 per cent when compared to the 1942-46 quinary period. The increment was 6.5 mm for the 1967-71 period or only 1.3 mm growth per year. This is especially low because the mean stand age at breast height was 27 years. Thinning in the 1950's would probably have prevented growth loss and would have maintained higher stand vigor.

Soil conditions

Eighty-six per cent of the infestations were located on poorly or very poorly drained soils (Table 3). Of these, 63 per cent involved the Fallsington or Othello soil series. The Fallsington series is characterized by a surface layer of sandy loam with a subsoil of sandy clay loam. The Othello series has a silt loam surface layer and a subsoil of silty clay loam.

Lorio (1968) indicated that soil conditions might be important, especially in the early stages of an outbreak. He found that 75 per cent of beetle infestation spots during a 5-year study period were found on imperfectly or poorly drained soils.

The poorly drained soils may be particularly sensitive to drought periods because they normally have an abundance of water. Dixon and Osgood (1961) also state that excess moisture may damage root systems and thus create favorable conditions for beetle attack. Possibly sweetgum or another tree species more tolerant of excess moisture conditions should be considered for management purposes on these poorly drained sites.

Climatological data

Two locations, Salisbury, Maryland, and Painter, Virginia, were selected for climatological data for the 12-year period from 1959-70. Salisbury data (Fig. 4) indicate the area had received the normal amount of precipitation during only two of the past twelve years. The cumulative

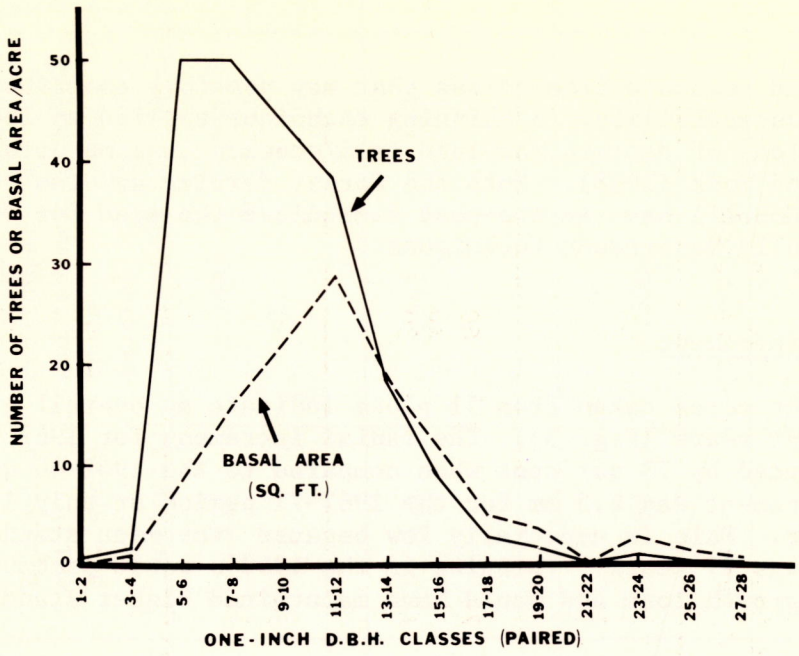


Fig. 2. Numbers of trees and basal area per acre by paired one-inch D.B.H. classes.

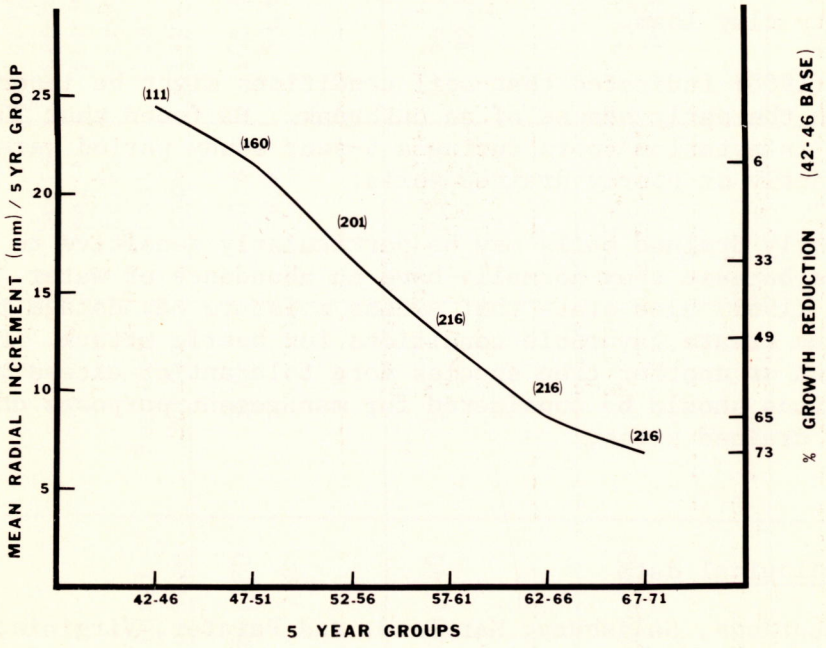


Fig. 3. Radial increment and per cent growth reduction at D.B.H. for fifty-one plots on the Delmarva Peninsula. (No. of observations in parentheses)

Table 3. Per cent of infestations of the southern pine beetle by soil associations for four Maryland counties.

County # Observations	Soil association or series	Drainage class[1]	Per Cent total land[2]	Per cent infestations[3]
Somerset	Othello-Portsmouth	P-VP	50	85
	Fallsington-Pocomoke-Woodstown	VP-W	11	15
13				
Wicomico	Pocomoke-Fallsington	VP-P	23	60
	Matawan-Norfolk	W	18	10
10	Fallsington-Woodstown-Sassafrass	P-W	17	30
Dorchester	Elkton-Othello	P	50	100
4				
Worcester	Fallsington	P		32
	Othello-Portsmouth	P-VP		26
17	Matapex	W		16
	Pocomoke	VP		11
	Woodstown	W		10
	Galestown	W		5

1/ Drainage classes: P-poor, VP-very poor, W-well.

2/ Figures for Worcester County are incomplete.

3/ Per cent of infestations ground checked which fell into a particular soil association.

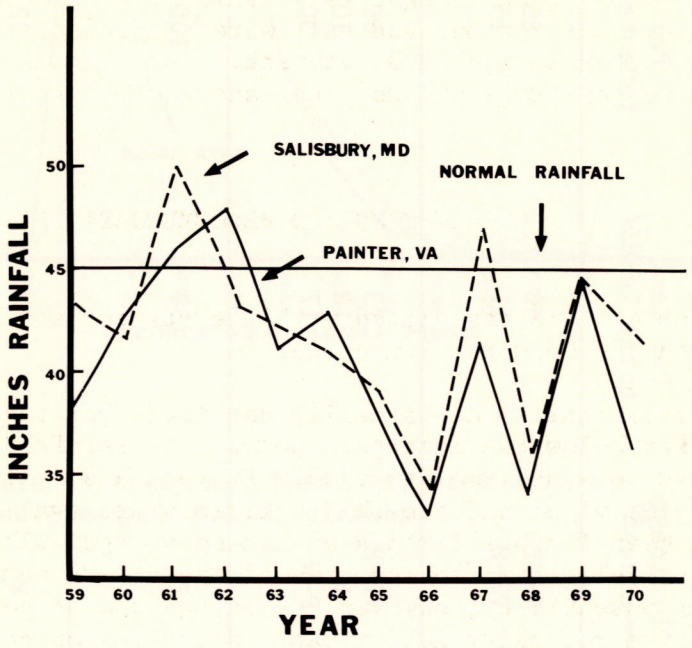


Fig. 4. Inches of precipitation for Salisbury, Md., and Painter, Va., from 1959-70.

rainfall deficit for this time period was 50 inches. In 1970, the rainfall deficit was 4.7 inches, with the months August through October accounting for 4.1 inches of the total deficit. This drought condition would coincide with the normal beetle population trend: low population in the spring with a gradual buildup in the summer and reaching its peak in late fall. Painter, Virginia, also has a similar rainfall deficit over the 12-year period. Only one year in the period had normal rainfall with the cumulative water deficit being 40 inches. Its 1970 deficit from August through October was 8 inches. Dixon and Osgood (1961) indicated that drought is associated with outbreak of the southern pine beetle. Late summer and fall water deficiencies might have been an important factor in the 1970 outbreak. Comparisons of actual and long-term mean temperatures did not indicate any abnormal deviations.

CONCLUSIONS AND RECOMMENDATIONS

Certain factors are associated with the current southern pine beetle outbreak on the Delmarva Peninsula.

1. Precipitation has steadily declined over the last decade, dropping far below the long-term norm. The rainfall shortage has contributed to a soil moisture deficit that has likely affected loblolly pine vigor and growth. Soil moisture availability might also have been further limited by extensive agricultural drainage efforts in fields surrounding some of the stands sampled; to verify the latter possibility, however, is beyond the scope of this survey. Loblolly pine mortality is, in fact, occurring on poorly-drained sites supporting pine. Historically, pine stands under moisture deficit or moisture excess have incurred particularly high levels of southern pine beetle infestation (Dixon and Osgood, 1961).

2. Dense stocking and high basal area combined with markedly reduced growth rates typify the 51 beetle-infested plots. These factors point to a fully- or over-stocked stand condition in which competition for moisture, nutrients and light reduces tree vigor and may contribute to beetle outbreaks.

3. The maintenance of a monoculture or single species type carries the excessive risk of high tree losses per acre in spite of its obvious economic advantages at time of final harvest.

To make workable management recommendations is difficult because the measures that are silviculturally within our capability are not always economically lucrative. It appears, nevertheless, that:

1. Loblolly pine management on the Delmarva Peninsula should, whenever possible, favor a broad-scale pulpwood or other type of commercial thinning program that retains stands in a vigorous growing state. More healthy stands may conceivably sustain lower incidence of beetle-caused tree mortality.

2. Any opportunity to manage for a mixed pine-hardwood type would also reduce per acre losses to the beetle; as a minimum, the hardwoods would guarantee some residual volume following possible pine beetle attack. This would be especially applicable on poorly drained soils where a more moisture-tolerant species might be considered.

3. In an outbreak situation, salvage logging should be regarded as a localized emergency control and economic necessity without reason to expect that it will ultimately accomplish the overall suppression of a beetle outbreak.

The most impressive conclusion gained from the survey is that preventive forest management is far more promising than an attempt to substantially reduce an extensive beetle population through salvage or chemical suppression.

LITERATURE CITATIONS

Bennett, W. H. 1965. Silvicultural control of southern forest insects. Proc. Fourteenth Forestry Symp. Louisiana State University. p 31-63.

Clerke, W. H., J. B. Hanson and P. J. Barry. 1971. Evaluation of southern pine beetle infestations on the Delmarva Peninsula in Maryland and Virginia. Rep. No. 71-1-15.

Craighead, F. C. 1925. Bark beetle epidemics and rainfall deficiency. J. Econ. Entomol. 18:551-586.

Dixon, J. C. and E. A. Osgood. 1961. Southern pine beetle: A review of present knowledge. U. S. Forest Service, Forest Exp. Sta. Paper 128.

Hall, R. L. 1970. Soil survey of Wicomico County, Maryland. U.S.D.A. Soil Conservation Service in cooperation with Maryland Agr. Exp. Sta., U. S. Government Printing Office, Washington. 90 p.

Little, S., J. J. Mohr and P. V. Mook. 1968. Ten-year effects from row thinnings in loblolly pine plantations of eastern Maryland. U. S. Forest Service, NEFES Res. Note NE-77. 8 p.

Lorio, P. L., Jr. 1968. Soil and stand conditions related to southern pine beetle activity in Hardin County, Texas. J. Econ. Entomol. 61:565-566.

Matthews, E. D. 1963. Soil survey of Dorchester County, Maryland. U.S.D.A. Soil Conservation Service in cooperation with Maryland Agr. Exp. Sta. U. S. Government Printing Office, Washington. 66 p.

Matthews, E. D. and R. L. Hall. 1966. Soil survey of Somerset County, Maryland. U.S.D.A. Soil Conservation Service in cooperation with Maryland Agr. Exp. Sta. U. S. Government Printing Office, Washington. 90 p.

U. S. Forest Service, Northeastern Area, State and Private Forestry. Forest Pest Control. 1970a. Survey of southern pine beetle damage Delmarva Peninsula, Maryland. Rep. No. D-7-70.

U. S. Forest Service, Northeastern Area, State and Private Forestry. Forest Pest Control. 1970b. Survey of southern pine beetle damage Sussex County, Delaware. Rep. No. D-8-70.

U. S. Forest Service, Southeastern Area, State and Private Forestry. Forest Pest Control. 1970c. Evaluating southern pine beetle infestations. Southeastern Area Publication No. 8. 34 p.

U. S. Soil Conservation Service. In preparation. Soil survey of Worcester County, Maryland.

More detailed information can be obtained by writing to the Forest Pest Management Field Offices listed below.

FIELD OFFICES	FOR THE STATES OF
Delaware Field Office W. L. Freeman, Jr., Field Representative Division of Forest Pest Management NA, State & Private Forestry, U.S.F.S. Box 365, Delaware, Ohio 43015 Phone: 614/369-4471	Delaware Illinois Indiana Maryland Missouri Ohio Pennsylvania West Virginia
Asheville Field Office J. L. Rauschenberger, Supervisor Division of Forest Pest Management SA, State & Private Forestry, U.S.F.S. Box 5895, Asheville, North Carolina 28803 Phone: 704/254-0961	Florida Georgia Kentucky North Carolina South Carolina Tennessee Virginia